CHAPTER 10
APPLICATION TO BUILDING FOUNDATIONS

10-1. General. All buildings, regardless of type and design, must be founded on and supported by competent soil or rock or the foundation must be modified to assure adequate support. Foundations may be in need of improvement for various reasons: e.g., to increase their strength or rigidity, to prevent the erosion of subsoil by adjacent water flow, to prevent cavity formation and soil shrinkage occurring as a result of water drawdown, to prevent subsidence and cavities created as a result of solution channels in underlying limestone, to prevent unbalanced soil pressure conditions resulting from differences in elevations, and to prevent the erratic behavior of soft clays subject to changing moisture conditions. This chapter is devoted to grouting of building foundations which have been found to be in need of improvement.

10-2. Pregrouting Investigation.

a. Physical and Mechanical Properties. The physical and mechanical properties of foundations must be thoroughly investigated and well defined during the planning of grouting treatments.

b. Field and Laboratory Testing. Investigations are normally conducted under the direction and supervision of the foundation engineer responsible for the design and construction of the foundation for the building. The major field tests may include standard penetration tests, visual classification of soils, grouting tests, geophysical explorations, and groundwater monitoring. Laboratory tests will normally include classification, moisture content, density, void ratio, chemical analysis of water, and strength tests.

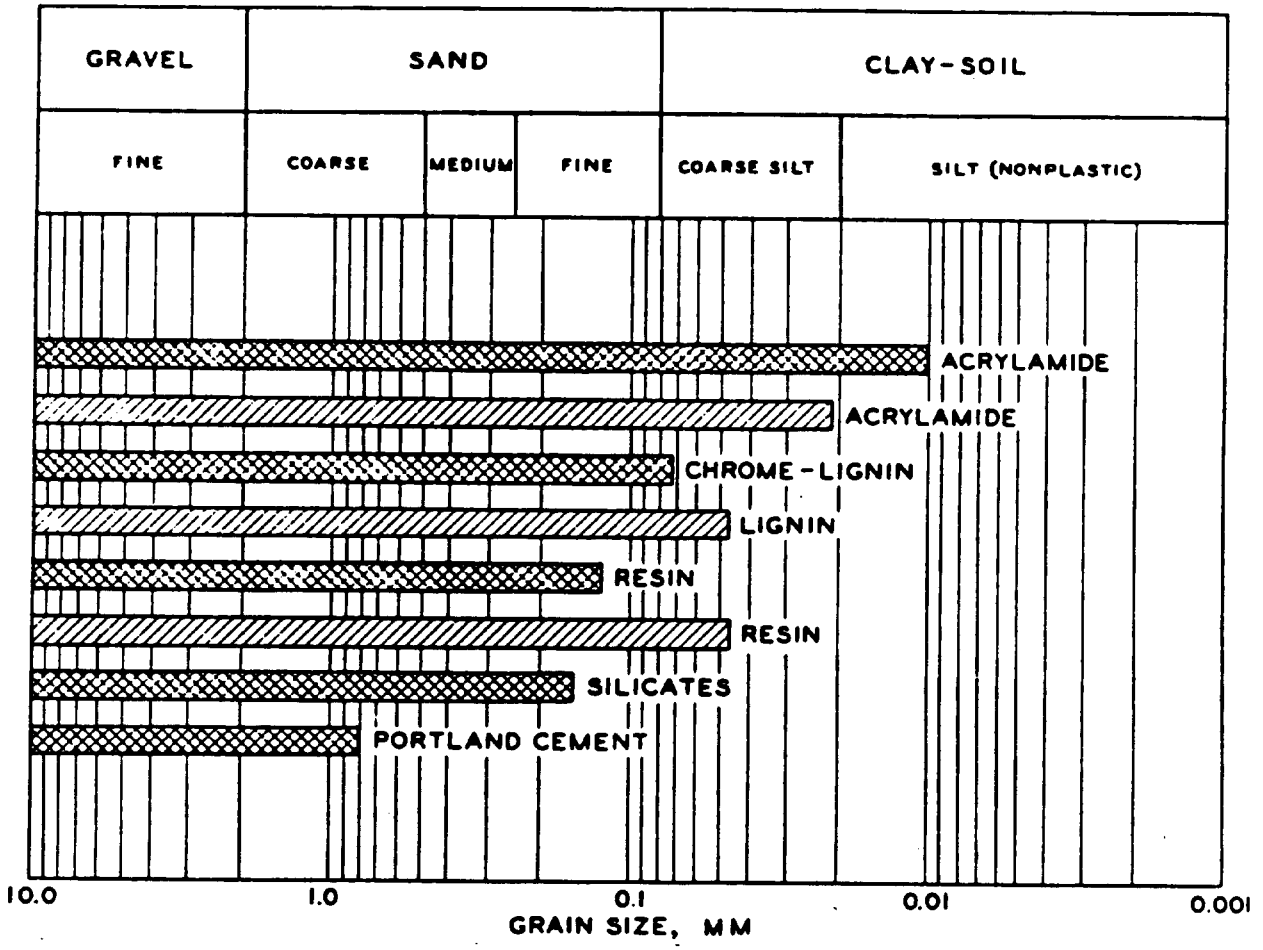
10-3. Soil Stabilization. A number of treatment methods have been successfully used to stabilize soil. Soil-cement and soil-asphalt mixtures are proven methods; however, their uses are limited to surface treatments. Intrusion grouting consists of mixing in-place soil and grout to form low strength soil-grout cylindrical piles. Compaction grouting consists of using very stiff consistency grout mixtures which, under closely controlled pressures, compact the soil by displacement. The grout remains a distinct mass in close contact with the compacted soil.

a. Intrusion Grouting. This type of grouting consists of mixing in-place soil and cement grout to form soil-grout cylindrical piles. This procedure requires specialized equipment which consists of a hollow tube with vanes at the lower end. These vanes are rotated slowly while being forced into the soil. This process permits either cement grout or chemical admixtures to be introduced through the tube for subsequent mixing with the soil to form a piling system.

b. Compaction Grouting. This method of soil stabilization consists of using stiff consistency cement grout mixtures which are pumped to subsurface

locations in predesigned patterns. The mixtures are placed using nonpulsating-type pumps under highly controlled pressures. The soil is stabilized by displacement. The grout remains a distinct mass in close interfacial contact with the compacted soil. Compaction grouting has been used to increase the bearing capacity of soils under slabs and spread footings, and to improve end-bearing and friction in pile foundations. Samples of the emplaced grout and compacted soil may be obtained for conducting desired laboratory tests.

c. Chemical Grouting. Chemical grouting may be used to control subsurface infiltration of water or to increase the mass strength of problem soils. The soil penetration range, by grain size, of the various chemicals is shown in figure 10-1. Distribution of the grout in foundation soils may, to a large



(Courtesy of American Cyanamid Co. and Halliburton Services)

Figure 10-1. Injectivity limit for grout

extent, be controlled by adjustment of the gel times. Generally, chemical grouts are considerably more expensive than the asphalt, cement, or clay grouts. Chemical grouting should be considered for those applications where their use is warranted to obtain desired results and when it is economically justified. Postgrouting field and laboratory testing programs should be conducted to determine the adequacy of the chemically grouted soil to support the foundation of the planned structures. (EM 1110-2-3504, and "Soils Engineering," R. H. Karol (app A).)

10-4. Rock Foundations. Grouting of rock foundations for buildings may be desirable in cases where the foundation rock is solutioned limestone, where it is highly fractured and broken, or where it contains open joints. The grouting will not only consolidate the rock and add to the bearing strength, but will aid in preventing piping of soils into the rock fractures and cavities. Grouting may also be used in jointed rock to consolidate the rock prior to blasting and excavating where close tolerances in excavation limits are required.